FENOC
FirstEnergy Nuclear Operating Company

James H. Lash
Site Vice President

724-682-5234
Fax: 724-643-8069

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L-06-001

Beaver Valley Power Station, Unit No. 1
Docket No. 50-334 License No. DPR-66
LER 2005-002-00

United States Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

The following Licensee Event Report is submitted:

LER 2005-002-00, 10 CFR 50.73(a)(2)(v)(A), "Latent Fire Protection Issue Regarding Possible Loss of Reactor Coolant System Makeup Function."

For James H. Lash

Attachment

c: Mr. T. G. Colburn, NRR Senior Project Manager
Mr. P. C. Cataldo, NRC Senior Resident Inspector
Mr. S. J. Collins, NRC Region I Administrator
INPO Records Center (via electronic image)
Mr. L. E. Ryan (BRP/DEP)

IE22

NRC FORM 366 (6-2004) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 6/30/2007

Estimated burden per response to comply with this mandatory collection request: 50 hrs. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by Internet e-mail to Infocollects@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

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4. TITLE

Latent Fire Protection Issue Regarding Possible Loss of Reactor Coolant System Makeup Function

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
11	18	2005	2005	- 002 -	00	01	13	2006	None	
									FACILITY NAME	DOCKET NUMBER

9. OPERATING MODE

1

10. POWER LEVEL

100

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*

- ☐ 20.2201(b)
- ☐ 20.2201(d)
- ☐ 20.2203(a)(1)
- ☐ 20.2203(a)(2)(i)
- ☐ 20.2203(a)(2)(ii)
- ☐ 20.2203(a)(2)(iii)
- ☐ 20.2203(a)(2)(iv)
- ☐ 20.2203(a)(2)(v)
- ☐ 20.2203(a)(2)(vi)
- ☐ 20.2203(a)(3)(i)
- ☐ 20.2203(a)(3)(ii)
- ☐ 20.2203(a)(4)
- ☐ 50.36(c)(1)(i)(A)
- ☐ 50.36(c)(1)(ii)(A)
- ☐ 50.36(c)(2)
- ☐ 50.46(a)(3)(ii)
- ☐ 50.73(a)(2)(i)(A)
- ☐ 50.73(a)(2)(i)(B)
- ☐ 50.73(a)(2)(i)(C)
- ☐ 50.73(a)(2)(ii)(a)
- ☐ 50.73(a)(2)(ii)(B)
- ☐ 50.73(a)(2)(iii)
- ☐ 50.73(a)(2)(iv)(A)
- ☒ 50.73(a)(2)(v)(A)
- ☐ 50.73(a)(2)(v)(B)
- ☐ 50.73(a)(2)(v)(C)
- ☐ 50.73(a)(2)(v)(D)
- ☐ 50.73(a)(2)(vii)
- ☐ 50.73(a)(2)(viii)(A)
- ☐ 50.73(a)(2)(viii)(B)
- ☐ 50.73(a)(2)(ix)(A)
- ☐ 50.73(a)(2)(x)
- ☐ 73.71(a)(4)
- ☐ 73.71(a)(5)
- ☐ OTHER Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER *(Include Area Code)*
L. R. Freeland, Manager Regulatory Compliance	(724) 682-4284

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX

14. SUPPLEMENTAL REPORT EXPECTED

☐ YES *(If yes, complete EXPECTED SUBMISSION DATE).* ☒ NO

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR

16. ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

In response to a corrective action from a previous Latent Issues Review performed in 2004, Engineering identified a new concern where the loss of the Beaver Valley Power Station Unit No. 1 (BVPS-1) Component Cooling Water System (CCR) could potentially result in saturation conditions at the suction of the operating Charging System pumps, leading to pump cavitation. The BVPS-1 Fire Protection Appendix R Report, does not take credit for operation of the CCR system since the original circuit analyses used other systems for its shutdown strategy. However, the BVPS-1 Fire Protection Appendix R Report did credit the Charging System with providing Reactor Coolant System (RCS) make-up during all postulated fire events. Cavitation at an operating Charging Pump suction could lead to subsequent pump damage, preventing this system from performing its credited safety function during certain postulated fire events.

This event is reportable pursuant to 10 CFR 50.73(a)(2)(v)(A) since the make-up function to the RCS, which is credited for maintaining the reactor in a safe shutdown condition, may not be available during certain postulated fire events. The root cause of this event is that wrong assumptions were made in the original basis for not needing CCR for seal water heat exchanger cooling in 1983. The risk is considered to be of very low safety significance. Applicable BVPS Unit 1 procedures were revised to eliminate the identified concern.

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17. NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)*

PLANT AND SYSTEM IDENTIFICATION

Westinghouse-Pressurized Water Reactor {PWR}
Reactor Coolant System {AC}
Charging System {CB}
Component Cooling Water System {CC}

CONDITIONS PRIOR TO OCCURRENCE

Unit 1: Mode 1 at 100 percent power

There were no systems, structures, or components that were inoperable at the start of the event that contributed to the event other than as described below.

DESCRIPTION OF EVENT

In response to a corrective action from a previous Latent Issues Review performed in 2004, Engineering identified on November 18, 2005, a new concern where the loss of the Beaver Valley Power Station Unit No. 1 (BVPS-1) Component Cooling Water System (CCR) from a postulated fire could potentially result in saturation conditions at the suction of the operating Charging System pumps, leading to pump cavitation. The BVPS-1 Fire Protection Appendix R Report, approved in 1983, does not take credit for operation of the CCR system since the original circuit analyses used other systems for its shutdown strategy. However, the BVPS-1 Fire Protection Appendix R Report did credit the Charging System with providing Reactor Coolant System (RCS) make-up during all postulated fire events. Cavitation at an operating Charging Pump suction could lead to subsequent pump damage, preventing this system from performing its credited safety function during certain postulated fire events.

Initially, two new scenarios were identified that could potentially lead to charging pump cavitation during certain postulated fire events. The first scenario involved continued normal letdown entering the Volume Control Tank at elevated temperatures due to the loss of CCR. However, subsequent review determined that this scenario would not lead to charging pump cavitation with the previous plant procedures that were already in place, and would no longer be reportable pursuant to 10 CFR 50.72(b)(3)(v).

The second scenario involves elevated Charging Pump suction temperature during an event involving minimum flow through the pump with a lack of seal water cooling due to the postulated loss of CCR. Following a loss of the CCR system during a postulated fire event, the letdown flow would be isolated by procedure due to the loss of the non-regenerative heat exchanger and its associated heatup of the letdown fluid.

DESCRIPTION OF EVENT (continued)

Following letdown isolation, charging flow into the RCS would be terminated by procedure to avoid overfilling the Pressurizer. Then, the only flow going through the operating charging pump would be the minimum charging pump recirculation flow plus the charging flow going to the Reactor Coolant Pump (RCP) seals. A portion of the RCP seal flow goes into the RCS and a portion is recirculated back to the charging pump suction. With the seal water heat exchanger cooling lost due to no CCR flow, the hot recirculated seal water is returned to the charging pump suction. Saturation conditions are not expected for the normal seal return rate of approximately 3 gallons per minute (gpm) flow from each RCP. However, it was now recognized that the amount of RCP recirculated seal flow increases with increasing seal injection temperature. Thus, the seal return rate could be higher than the previously calculated rate of 3 gpm since the loss of CCR would result in higher than normal seal injection temperature. An increased seal return rate could result in saturated conditions occurring at the charging pump suction piping. Since the CCR circuits were not previously analyzed, the redundant circuits were assumed to fail due to the postulated fire event.

This concern for a loss of CCR is limited to postulated Appendix R fire events since two independent trains of CCR are required by plant Technical Specifications for plant operation and would preclude a complete loss of CCR for non-fire related postulated accidents.

REPORTABILITY

This event is reportable pursuant to 10 CFR 50.73(a)(2)(v)(A) since the make-up function to the RCS, which is credited for maintaining the reactor in a safe shutdown condition, may not be available during a postulated fire event. This loss has been shown to occur in a deterministic evaluation for certain postulated fire events which presume that 1) the one fire protected train of the charging system is operating at the time of the postulated fire and is made unavailable due to described pump suction cavitation, and 2) all components not credited in the licensing basis as having fire protection within the area containing the postulated fire are made unavailable due to the postulated fire, which includes the three CCR pumps and the two non-fire protected charging pumps. This event was previously reported pursuant to 10 CFR 50.72(b)(3)(v)(A) on November 21, 2005 per EN number 42162.

This event is not reported pursuant to 10 CFR 50.73(a)(2)(ii)(B) as an unanalyzed condition that significantly degrades plant safety since, as shown in the Safety Implications Section below, the risk as determined by Probabilistic Risk Assessment (PRA) is considered to be of very low safety significance.

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CAUSE OF EVENT

The root cause of this event is that wrong assumptions were made in the original basis for not needing CCR for seal water heat exchanger cooling in 1983. This resulted in BVPS Unit 1 not being in compliance with its licensing basis, specifically the provisions of 10 CFR 50, Appendix A, Section III.L.2.b, which requires a reactor coolant makeup function.

Event Analysis

The new concern involves a postulated fire in several plant areas, which disables CCR and leads to the loss of the non-regenerative heat exchanger. Thus, this leads to the eventual isolation of the RCS letdown flow. The loss of letdown requires manual actions to isolate normal RCS charging flow in order to prevent overfilling the Pressurizer. With normal makeup flow into the RCS terminated and no CCR cooling to the seal water heat exchanger, the only charging flow going into the RCS is through the RCP seals. In this condition, the temperature of the charging pump flow going to the RCP seals would be increased above the normal condition of approximately 140 F where approximately 3 gpm per RCP seal is being returned to the charging pump suction. With seal return flow rates now reaching approximately 4 gpm per RCP seal (due to the increased seal injection temperature) and combining with the normal pump recirculation flow of approximately 60 gpm, the fluid in the charging pump suction piping has been calculated to rise very rapidly (less than 10 minutes) to saturation leading to charging pump cavitation due to loss of NPSH. The BVPS Unit 1 multi-stage charging pumps can be significantly damaged when operated with cavitation, potentially leading to the loss of the operating charging pump.

BVPS Unit No. 2 fire protection design and licensing basis credits the Component Cooling Water System following a postulated design basis fire event. Thus, the newly identified BVPS Unit 1 scenario was not applicable to BVPS Unit 2 since its designed plant protection and plant procedures address maintaining continued component cooling water flow following a postulated fire, preventing the BVPS Unit 1 scenario from occurring at BVPS Unit 2. However, subsequent review has resulted in additional enhancements to the BVPS Unit 2 fire protection procedures.

SAFETY IMPLICATIONS

It was identified that for certain postulated fires, a loss of CCR to the Seal Water Heat Exchanger and the Non-regenerative Heat Exchanger at BVPS Unit 1 would result in high fluid temperatures at the suction of the credited charging pump and may result in the charging pump cavitating. In the current PRA fire model, it is not assumed that the failure of CCR results in the guaranteed failure of the charging pumps unless the fire also damages them or their cables. Therefore, to assess the risk associated with this issue, it

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SAFETY IMPLICATIONS (continued)

was assumed that any fire area identified in the affected plant areas that impacted CCR as analyzed in the PRA fire model, which lead to the total loss of CCR, would also lead to the failure of the running charging pump. The remaining charging pumps would be available to provide RCS makeup and seal injection unless they too were impacted by the fire or failed probabilistically.

It was also assumed in the risk assessment that if the analyzed fire was located in the control room boundary, the operators would induce a loss of offsite power and would not load the CCR pumps onto the emergency diesel generators per the alternate safe shutdown from outside the control room procedure. Therefore, all of these analyzed control room fires would result in the total loss of CCR and failure of the running charging pump.

If the accident sequence progresses to the total failures of both CCR and charging/high head safety injection pumps, a consequential RCP seal LOCA (Loss Of Coolant Accident) would result due to the loss of all RCP seal cooling. In this risk assessment, it is assumed that the probability that the resultant RCP seal LOCA exceeds 21 gpm per pump is the same as those assumed in the station blackout PRA model (i.e., there is a 22 percent chance that the leak is greater than 21 gpm). However, even with the loss of RCS inventory, it in itself does not go to a core damage sequence unless Auxiliary Feedwater (AFW) and Dedicated AFW fail (no credit for Main Feedwater or condensate was given), or the operators fail to cooldown and depressurize the Reactor Coolant System to limit the leakage and allow for a Low Head Safety Injection pump to provide RCS makeup.

To assess the baseline core damage frequency associated with the identified fire areas, it was also assumed that any analyzed control room fire would also result in the complete loss of CCR, but would not impact the charging pump unless the fire also damages it or its cables.

Therefore, the risk is determined by calculating the change in core damage frequency. This risk is considered to be of very low safety significance.

CORRECTIVE ACTIONS

1. Immediate actions were taken to post fire watches in the areas where it was identified that a postulated fire could disable the BVPS Unit 1 Component Cooling Water System.

2. Applicable BVPS Unit 1 procedures were revised to eliminate the identified concern. These procedures were revised to ensure Reactor Coolant Pump seal leakoff is isolated

CORRECTIVE ACTIONS (Continued)

when CCR is lost and to place the charging pumps in the Pull-To-Lock position prior to leaving the control room when control room evacuation is needed.

3. A review will be performed to review the BVPS Unit 1 Fire Protection Appendix R Review Report to determine if there are any other scenarios that credit or require CCR system components.

4. An operating experience has been issued to the industry describing this event.

5. In a letter dated December 22, 2005, BVPS stated its intention to pursue implementation of NFPA 805, Performance-based Standard for Fire Protection for Light Water Reactor Generating Plant. Implementation of this standard will revise the BVPS fire protection design basis from the previous deterministic-based analyses, where the initial error occurred, to a more risk-based approach.

Completion of the above and other corrective actions are being tracked through the BVPS corrective action program.

PREVIOUS SIMILAR EVENTS

A review found one prior BVPS Unit 1 and no BVPS Unit 2 Licensee Event Reports within the last five years involving a fire protection issue:

BVPS Unit 1 LER 2003-002, "Potential Overpressurization of Unit 1 Cable Vaults if a CO2 Discharge were to Occur, Results in an Unanalyzed Condition."

BVPS Unit 1 LER 2003-002 is similar to this LER in that it involved an original design concern that was not recognized during the initial program development. It was, however, different from this LER in that it involves the use and credit for the carbon dioxide suppression system, rather than the lack of use and credit for the Component Cooling Water System.

COMMITMENTS

There are no new commitments made by FirstEnergy Nuclear Operating Company (FENOC) for BVPS Unit No. 1 in this document.